AGRICULTURAL
# Research
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MEASURING SNOWFALL ACCUMULATION FROM THE AIR/Page 3

AGRICULTURAL
# Research

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## The Many Disciplines

"What do you mean you're using a *hair* to detect bacterial spot in pepper plants?" the reporter asked.

"That's right . . . but it's spelled h-a-r-e," the scientist replied.

The reporter's look of incredulity changed to one of serious interest as the scientist explained how rabbits develop an antiserum in their blood when injected with the bacterium from infected pepper plants (see page 14).

This research illustrates the many approaches—and disciplines—required in developing ways to control pests.

A plant pathologist is studying bacterial spot in pepper plants. But to carry the study further, a plant geneticist asks, "Can we develop peppers that are resistant to bacterial spot?" An agronomist ponders, "Is there a cropping procedure that will help?" And a soil scientist inquires, "Does this bacterium overwinter in the soil?"

Many scientific disciplines were focused on developing safer and more efficient low-volume aerial treatments against insects (see page 10). To mention a few, agricultural engineers tested spray nozzles and equipment, entomologists studied effects on insects of varying rates of malathion, and veterinarians examined effects of low-volume spray on livestock.

The result: Insects are being controlled with much less chemical per acre—5.3 ounces instead of 16, in the case of cereal leaf beetles. Cost of materials and application was reduced 65 percent—and with superior results, to boot.

An entomologist and a plant geneticist joined forces to find a strain in alfalfa that is resistant to the alfalfa weevil (see page 12). The entomologist studied the weevil in detail—to learn its habits and discover its weaknesses. The geneticist searched for plants having heriditary characteristics that would capitalize on these weaknesses.

Their investigations closed in on the insect's method of laying eggs in alfalfa stems. An Algerian strain of alfalfa, they found, has solid stems that resist egg laying by this pest. The challenge now is to transfer this genetic characteristic into commercially acceptable alfalfa varieties.



*Editor: R. E. Enlow*
*Contributors to this issue:*
*D. W. Goodman, M. E. Haun, W. W. Martin, D. H. Mayberry, J. G. Nordquist, F. J. Parks, J. H. White, J. M. Singer*

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**Orville L. Freeman, Secretary,**
**U.S. Department of Agriculture**

**B. T. Shaw, Administrator,**
**Agricultural Research Service**

# Measuring Snowfall Accumulation...From the Air

*Idaho study could affect water users throughout the Pacific Northwest*

■ Aerial mapping may prove to be an efficient—and less costly—way of estimating the depth and volume of snow cover in mountainous areas, thereby improving the accuracy of streamflow forecasts.

The mapping technique is being applied by ARS engineers and other scientists from the Northwest Hydrology Research Watershed, Boise, Idaho, as part of intensive studies of two sagebrush-covered watersheds in the mountains of southwestern Idaho.

The researchers are also evaluating a method of measuring the water content of a snowpack by using a snow "pillow," 12 feet in diameter and filled with 300 gallons of antifreeze. The pillow activates a manometer (a pressure gage) that responds directly to the weight of the snow and provides a continuous measure of water content.

The findings could benefit water users throughout the Pacific Northwest, where snow surveys supply information of vital importance to irrigation districts, power companies, municipalities, industry, and recreation developments. Also, from this research, may come more useful annual estimates of water resources as stored snow, improved forecasts of winter floods, and—eventually—methods of increasing moisture storage and regulating the release of snowmelt water from sagebrush ranges.

Weekly ground measurements are taken of the depth and water content of the snow at 60 sampling points scattered over each watershed. Besides adding to total research findings, the ground measurements serve as a check against results obtained from aerial mapping and the snow pillow techniques. This information is supplemented by data on soil moisture, climate, topography, vegetation, and runoff.

*ABOVE—A snow sampling point is premarked for aerial mapping of snow depth. ABOUT THE COVER—Ground survey crew weighs a standard snow sampling tube to obtain snow depth and density.*

The studies, cooperative with the Idaho, Oregon, and Washington Agricultural Experiment Stations, are on land at elevations of 5,800 to 6,900 feet in the Reynolds Creek Experimental Watershed about 50 miles southwest of Boise. Land access rights have been given by ranchers of the Owyhee Soil Conservation District and the U.S. Bureau of Land Management.

The most promising way of increasing the accuracy of streamflow forecasts is by improving the reliability of data on snow depth and water content. Although the statistical meth-

# Measuring Snowfall Accumulation...From the Air *(Continued)*

ods now employed in making streamflow predictions are highly efficient. they are based on snow measurements obtained under the most difficult conditions. Ground crews must survey areas that are accessible only by special over-the-snow vehicles and skis, and they must be prepared to "wait out" storms at an improvised mountain camp.

Ground observations would still be necessary, in conjunction with aerial mapping, but they could be reduced substantially. (The scientists don't rule out the possibility that—one day—it might be possible to develop a system, employing both aerial photography and snow pillows, or other concepts—that would eliminate the ground observations entirely.)

Mapping from the air, meanwhile, has permitted the use of entire representative areas, ranging from 20 to 80 acres each, as single sampling points. A ground observer, in contrast, takes five samples for each area to obtain information that is representative of the area.

In applying the photographic technique, the scientists obtained two sets of aerial photos of each sampling site—one made with no snow on the ground and one after snowfall. They locate corresponding areas on the two photos, measure differences in surface contour in the photos, and then calculate the volume of snow from the contour differences. Using the snow volume and ground-read density figures, they can then estimate the amount of water stored as snow.

The studies show wide variation in snow depth and density—about half of the area containing 80 percent of the snow volume and snow water. The density of accumulated snow increases with time during the winter, whereas variations in density from place to place remain about the same.

As part of the snowpack studies, the researchers are gathering detailed information on how topographic and climatic conditions influence the timing and amount of snowmelt on the two watersheds. The sagebrush range, rather than the high mountains, is the chief source of frequent winter floods in the Snake River Valley. With this added information, they hope to improve the accuracy of flood forecasts.

No previous research has been conducted on the behavior of snow in shrub areas of the Northwest. There are indications that improving the quantity or timing of flow of snow-fed streams might be possible, for example, by manipulating vegetation. But such practices would require an understanding of the reasons for variations in snow drifting and snowmelt rates.☆

*Observation crew travels over most difficult terrain through adverse weather conditions to obtain necessary information on snow cover. Here, the crew measures snowpack water content with a neutron probe.*

*A biologist examines body tissue through an electron microscope to determine effect of diet on the tissue.*

# Do Diets Affect Length of Life?

■ A better understanding of the relationship of diet to body function and length of life is coming from a series of long-term studies being conducted by ARS human nutritionists.

In one of these studies, laboratory rats at the Agricultural Research Center, Beltsville, Md., were fed 29 different nutritionally adequate diets. The basic diet consisted of casein, lactalbumin, yeast, mineral-salt mixture, hydrogenated vegetable oil, sucrose, and celluflour. This diet was varied, depending on the experiment, by substituting part of the basic diet with natural foods.

In one group of experiments, for example, only the source of protein and fat was varied by substituting egg, milk, beef, or peanut butter for 20 to 25 percent of the basic diet. In another group of tests, the source and level of protein remained constant but the kind and level of fat were varied.

Results of these experiments showed that even when nutritionally adequate diets are fed, differences in survival are observed. And these differences are due, in part at least, to the way an animal makes use of different combinations of foods.

The particular combination of foods in a diet seemed to play a bigger role in the way foods are used than the individual foods being tested, the scientists learned. For example, rats lived as long when their diet consisted of 100 percent egg as they did on the basic diet with no egg. But when they were fed a diet containing 25 percent egg, length of life was significantly shortened.

Another indication of the importance of this interaction of foods is found in studies of cholesterol levels in blood serum. In the Beltsville experiments, cholesterol levels in the blood of the test animals had no consistent relationship with the kind or level of fat, or the level of cholesterol in the diet.

For example, rats fed the basic diet generally had low cholesterol levels at all ages. However, when some of the basic diet was replaced with natural foods—beef, milk, peanut butter, or egg—serum cholesterol levels tended to be high in older rats.

Some extremely high levels of serum cholesterol were developed in rats fed 25 percent egg diets, which were high in cholesterol. But cholesterol levels also tended to be high in rats fed a peanut butter diet, even though the cholesterol level of this diet was low. And cholesterol levels were lower in rats fed a diet of 100 percent egg yolk, which was very high in cholesterol.

In another part of this same experiment, the researchers found that heredity played a great part in the reactions of animals to diet. When two strains of rats were fed under identical conditions a diet containing 25 percent egg, there was an average difference of 200 days in the survival between the strains (200 days are equal to about one-third the normal lifespan of a laboratory rat).

Another interesting finding from the entire series of studies was the effect of overeating on the lifespan. Rats that ate excessive amounts of food and gained weight at a rapid rate died at an early age regardless of the composition of the diet.

Interpreting the results of diet studies, the ARS scientists caution, may be complicated by excessive weight or heredity of the subjects. Also, caution is needed before implicating any specific food in the adverse effect of diet without considering its possible interaction with other dietary ingredients.☆

# Improving

# Soybean Oil

*Laboratory techniques make oil more stable, prevents formation of solid fat*

■ Utilization scientists have found new laboratory methods of preventing unpalatable flavors from developing in soybean oil through oxidation of the oil's linolenic (fatty) acid.

This development could have widespread significance in expanding markets for soybean oil, particularly for cooking and for export. About two-thirds of the total domestic consumption of edible vegetable fats and oils comes from soybeans.

In the laboratory techniques, the scientists react the linolenic acid with hydrogen (hydrogenation). Once most of the acid has reacted with hydrogen—and is converted to a more stable fatty acid—it is no longer free to react with oxygen. And the off-flavor does not develop.

These studies, by chemists at the Northern utilization research laboratory, Peoria, Ill., are an outgrowth of the identification at Peoria of linolenic acid as a flavor destroyer in vegetable oils (AGR. RES., April 1964, p. 10). Oilseed research at Peoria is headed by ARS chemist J. C. Cowan.

The chemists have developed two new laboratory methods of hydrogenating linolenic acid. One involves the use of solvents and the other the use of new metal compounds. In neither case are fatty acids other than linolenic affected materially. And the production of solid fat byproducts is kept to a minimum.

Industrial application of the new techniques would increase the use of soybean oil (1) as a cooking oil in restaurants and in the manufacture of such foods as potato chips, where cooking oil is kept at high temperatures or heated and reheated repeatedly; and (2) as an export product to areas of the world where the demand for salad and cooking oils has outstripped production. Export can expose oils to air and storage temperatures for long periods, causing oxidation and deterioration of unstable oils.

The Peoria scientists say that their techniques hydrogenate the linolenic acid without producing a significant amount of solid fat in the soybean oil. This could eliminate "winterizing," a step employed in one form of processing whereby the temperature of the oil is lowered and solid fats filtered out.

Using the solvents, utilization chemists Sambasivarao Koritala and H. J. Dutton were able to reduce the linolenic acid content of soybean oil to less than 2 percent—a definite improvement compared with a content of about 3 percent in liquid soybean oil made from the hydrogenation-winterization process. They employed such solvents as dimethylformamide, furfural, acetonitrile, tetramethyl urea, and trimethyl phosphate.

Linolenic acid reacted twice as fast in the solvent technique as it does in conventional hydrogenations, and it reacted about four times as fast as the other components in the oil.

In a related study, using new metal catalysts (acetylacetonates), chemists E. A. Emken, E. N. Frankel, and R. O. Butterfield found that the soluble metal-organic compounds favor the reaction of hydrogen with linolenic acid more than reactions with other fatty acids. This selectivity is about twice that of the insoluble nickel catalyst that is now being used generally by industry.☆

# Monitoring Pesticides

*Intense assessment is being made of role of pesticides in environmental contamination*

■ ARS is probing deeply into the pesticide residue question with a field monitoring program.

This program is designed to show how much—if any—pesticide residue accumulates in various components of the environment when (1) an area is exposed to normal pesticide use, and when (2) large-scale, Federal-State pest control operations are carried out.

For the public at large, the result will be a scientific assessment of the role played by pesticides in environmental contamination.

For State and Federal agencies, it will mean a sounder foundation for planning pest control research, recommendations, and regulatory programs. For the chemical industry, the information will serve as a guide in developing safer pesticide compounds and equipment.

Data obtained in this large scale monitoring program will be made after sufficient information has been obtained and adequately studied and evaluated.

The ARS monitoring program began last summer in the Mississippi River Delta to determine the level of residues resulting from normal use of pesticides. The study covers existing pesticide-residue levels in soils, water, crops, livestock, and certain species of water and land animals. Special attention is being given to nontarget insects, including honey bees and other beneficial species. Monitoring will continue for at least 3 years.

Five locations—all part of the Mississippi River drainage area—were selected for the initial project. Two of the sites are in Arkansas, and three are in Mississippi.

The study areas are identical in every way possible—except for contrasting pesticide use by the farmers. If one area has soybeans, corn, and cotton, for example, the companion study area must also have these crops. Each area must contain at least one water source—a pond, stream, or drainage ditch—and wildlife habitats. It was desirable, however, that the areas being compared differ greatly in the amount and kind of pesticides used and the methods used to apply them.

A field team supervised by an entomologist is assigned to each location, where samples are collected of soil, water, silt, crops, nontarget insects, and representative land and aquatic animals. The team also records current pesticide use on each block, noting the kind, amount, and method of application; and where possible, records are being obtained on past pesticide and land use dating back to 1954 or earlier.

*Water is collected from lakes, wells, cisterns, and other sources and shipped to the laboratory in sterilized glass bottles. To guard against contamination in storage, the bottles are carefully sealed and wrapped in aluminum foil.*

Samples are carefully sealed and protected against contamination both while in storage at each location and in shipment to a laboratory in Gulfport, Miss., where they are processed and analyzed for the kind and amount of pesticide residue present.

In addition, the supervising entomologists at the five locations record about a hundred observations each week during the growing season. These include samples collected, insect light and pitfall traps, and weather and land use data.

Similar monitoring programs have been started at Grand Forks, N. Dak. and at Yuma, Ariz.

ARS has also strengthened its regular programs to obtain information that can be used to assess the impact of Federal-State pest-control operations on the environment in several States. Added monitoring information was obtained during 1964 in such cooperative programs as the control of boll weevils in Texas, burrowing nematodes in Florida, cereal leaf beetles in Michigan, grasshoppers in Wyoming, gypsy moths in New Jersey and Pennsylvania, Japanese beetles in Michigan and Illinois, and witchweed in North Carolina and South Carolina.☆

# RESEARCH GAINS . . . On African Swine Fever

## How Severe IS African Swine Fever?

■ "African swine fever is potentially the most devastating of all hog diseases. Its introduction into countries having intensive hog production would result in most serious socioeconomic losses."

This statement was made by a man who spent more than 7 years in Africa doing research on African swine fever and other livestock diseases.

D. E. DeTray, assistant director of the Animal Disease and Parasite Research Division of ARS, also says that the disease is one of the most complex ever studied. It kills nearly all infected domestic pigs, and those few that survive are carriers capable of spreading the infective virus. There is no effective treatment for ASF and no safe, reliable vaccine.

Because it is such a serious threat, ARS has been cooperating with other nations in studying ASF since 1954 (see adjacent article). Research on this disease is conducted in foreign nations and at Plum Island Animal Disease Laboratory, Greenport, N.Y.

The disease presents no problem to wart hogs, bush pigs, and perhaps other wild animals that can carry and spread the virus. How the disease is spread to domestic pigs is not definitely known.

In some areas of Africa the incidence of ASF was greatly reduced after double fences were placed around farms to keep wild hogs away from fields where farm pigs are raised. But transmission experiments to substantiate these field results have not yet been conclusive. Spanish studies indicate that ticks may be at least partially responsible for spreading the disease from wild to domestic pigs.

Once ASF gets into domestic hogs, however, it is easily spread by contact. Blood, feces, urine, and all body tissues are loaded with the virus.

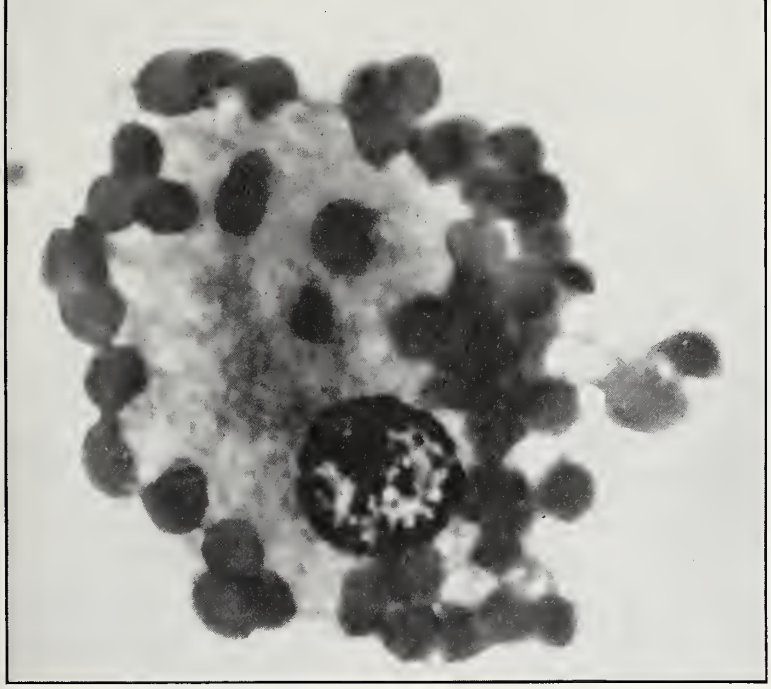
Although ASF looks and acts like acute hog cholera in the field, it is an entirely different disease. Hogs immune or even hyperimmune to hog cholera are completely susceptible to ASF; hogs immune to ASF are susceptible to hog cholera virus.☆

■ African swine fever may be transmitted by ticks . . . a chronic form of the disease exists . . . a special diagnostic test for this chronic form may be needed . . . and a vaccine may be developed for the dread disease.

These developments have resulted from studies in Spain under a Public Law 480 grant awarded by ARS to the Spanish Government's Pathology Service in Madrid, where scientists conducted an animal disease eradication program. Using a swine fever diagnostic test developed by ARS, they were trying to determine whether the test could be relied on in the field during large-scale epidemics such as occur in Spain.

Early diagnosis of African swine fever is especially important because clinical signs are similar to those of hog cholera, and if the disease should get into the United States, the big problem would be to distinguish it from hog cholera.

While the Spanish scientists were conducting the program, they found that a genus of ticks carries the African swine fever virus. This is a possible explanation of one way the dis-



*In the hemadsorption test for African Swine fever, red blood cells gather around white cells—if the virus of the fever is present in culture. This enlarged photo shows red cells around a single white cell.*

ease might be transmitted from wild hogs to domestic hogs.

The carrier tick is the species *Ornithodorus erraticus*. In order to prove that the tick carries the swine virus, the Spanish scientists ground up ticks obtained from infected hogs, prepared an inoculum from the ground ticks, and injected the inoculum into several hogs. All the hogs inoculated developed African swine fever.

During the 3 years the Spanish scientists have been testing the diagnostic method, they have observed changes in the way the disease affects hogs under farm conditions. These observations have led them to laboratory experiments which indicate that a new diagnostic test may be needed—and to the theory that effective vaccination might be possible.

The number of hogs that recover from the disease has been increasing; and when the disease strikes one hog in a herd, there is now a longer time before all hogs contract the virus. During the first 2 years of the experiments, all hogs that took the disease died from it. Also, it was common in some areas for 100 to 300 animals to die in less than 10 days after the disease struck one of the group. Now, at times it takes 20 to 30 days for the disease to affect all hogs in a large herd.

These observations led to the discovery that there is a chronic as well as an acute form of African swine fever. The Spanish scientists inoculated a number of hogs with the mild strains, and some of these hogs lived for 3 to 6 months before dying. However, hogs inoculated with one lot of material lived a year, which led the experimenters to theorize that a vaccine might be developed with the virus that causes the chronic form.

At present, the only method of controlling African swine fever is the slaughter of all diseased hogs and subsequent enforcement of quarantines. This method has cost the Spanish Government about $23 million since the disease was introduced into that country in 1960. The Government pays indemnity for all hogs killed.

The diagnostic method the Spanish scientists were testing was the hemadsorption test, developed in Africa by ARS scientists. In this test, blood or spleen from a hog suspected of having African swine fever is mixed with a culture made from white blood cells of a healthy hog. If the disease is present, the red blood cells form into clumps around the white blood cells.

Hog cholera does not produce hemadsorption. Before ARS scientists developed this test, there was no laboratory method of diagnosing African swine fever or distinguishing it from hog cholera.

The Spanish scientists found the hemadsorption test 100-percent reliable in testing hogs that had died from virulent strains of African swine fever virus. The results could be determined in 24 hours.

But they found that it took several days for hemadsorption to become visible with the mild strains of the virus. In these cases it has been necessary to prepare a subculture in order to make a diagnosis using the hemadsorption test. Several days may be necessary to arrive at a diagnosis—serious delay when large numbers of samples are being submitted for diagnosis.

The Spanish Government's Pathology Service will seek additional information on tick transmission, the possibility of a vaccine, a diagnostic method for mild strains, and the length of time the virus lives in the meat of slaughtered diseased hogs.

Grants awarded under Public Law 480 are paid for with money that has accrued to the United States from the sale of surplus agricultural products abroad. This money cannot be converted into dollars for use in the United States.☆



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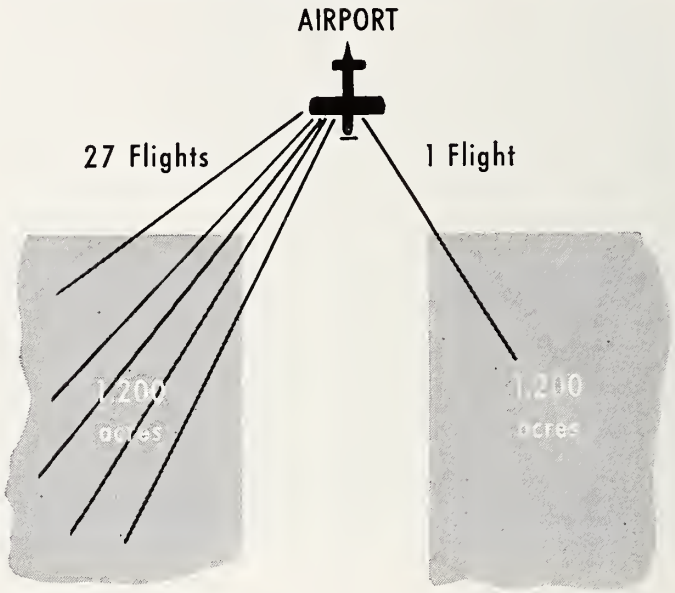
# EFFICIENT AERIAL SPRAYING

## • On Low Volume Sprays




Old High Volume Treatment

New Low Volume Treatment

■ New uses are being found for the low-volume aerial spray technique developed recently by ARS for use against plant pests.

The new technique involves applying undiluted, technical malathion in extremely small amounts. Conventional applications of pesticides by aircraft involve diluting the chemical with a large amount of water, oil, or other diluent.

The low volume method was first tested on grasshoppers in 1962. Results were so outstanding that low-volume malathion became the standard treatment in the rangeland grasshopper program in 1964 (AGR. RES. July 1964, p. 11).

Heartened by the early success against grasshoppers, plant pest control workers began testing the technique against other insect pests; and it is now being used in the cereal leaf beetle program in the Midwest and the boll weevil program on the Texas High Plains.

Briefly, here are the principal advantages of the low-volume technique:

• Use of an insecticide with low toxicity to warm blooded animals greatly minimizes possible adverse effects to humans, livestock, and wildlife. It's possible to apply malathion on rangelands, for example, without removing livestock from the range.

• Higher flights are made practicable by the use of a nonvolatile material such as malathion. It was possible to use a 100-foot swath in the boll weevil program rather than the 35-foot swath normally used. This adds to the safety of flight operations, increases the amount of work plane and pilot can do, and reduces the complexity of supervision and ground support.

• Reduction in total material applied per acre (97 per cent in the boll weevil program) means a sharp reduction in application costs.

Some specific examples of benefits derived from the new pesticide application technique:

In 1963, the cereal leaf beetle treatment consisted of applying 16 ounces of malathion per acre as a 1-gallon water emulsion. In 1964, in the low-volume technique (without the water), dosage was cut to 8 ounces of technical malathion and later to 5.3 ounces per acre. The cost of material and application was reduced more than 65 percent, and the results were superior to those in 1963.

This year in the Texas High Plains, a campaign was begun to stop the westward spread of the boll weevil, which has been gradually adapting itself to environmental conditions once thought unsuited to it.

Following two series of successful tests with the low-volume technique, malathion was selected for use in the fall—to kill the weevils before they had a chance to go into hibernation. By systematically cutting down weevil populations each fall, the campaign officials believe the weevils can be pushed back beyond a natural barrier of land on which no cotton is grown. Once this is accomplished, it should be possible to keep the pest contained in back of the natural barrier with limited, local treatments.

The High Plains fall treatment has been carried out at less than half the cost of conventional methods and with a considerable increased safety margin. The low-volume application allowed 20 planes to do the work that 80 would do otherwise, and the planes were able to fly higher and thus more safely.

# . . . through research

*Several types of aircraft and spray equipment were tested.*

## • On Atomized Droplets

■ Uniform distribution of pesticide over an area being treated by aerial spraying lessens the possibility of overdosing portions of the area, cuts the total quantity needed per acre, and provides better pest control at less cost.

This desired distribution depends in large part on the size of the droplets (degree of atomization) of the pesticide or herbicide sprayed. Atomization also affects loss of spray through evaporation, drift, and convection air currents, as well as effectiveness of the spray against the pest.

As a part of long-term research to improve the efficiency of spray equipment, formulas, and application techniques, scientists of ARS and the Forest Service are conducting atomization tests with oil-base and water-base sprays. Selecting the most effective base to use in an actual spraying operation depends upon the nature of the insecticide itself, the type of pest against which it is being used, and the kind of crop or forest acreage to be sprayed.

For aerial operators who use oil-base sprays, agricultural engineers D. A. Isler and J. B. Carlton recently compiled and reported data on how the mechanics of spraying affect the degree of atomization. These include the airspeed of the plane, direction that the nozzle is pointed in relation to direction of the aircraft, the size and type of nozzle, and spray pressure.

Isler and Carlton used two airplanes, flying at speeds of 80 to 200 miles per hour over predetermined lines in the sampling areas. Small cards were clipped to aluminum plates at 5- or 10-foot intervals along the lines. About 5 minutes were allowed after the plane had passed over a line to insure that the spray, containing a black dye, had settled on the sampling cards. Then the cards were collected and brought to the laboratory. From an examination of the spray drops on each card, researchers were able to determine the degree of atomization.

Two types of nozzles disseminated the spray: flat or slit type and hollow cone. Although diaphragm check valves with no nozzles were also tested, they were quickly found unsatisfactory when used in a forward direction.

Airspeed and nozzle direction, primarily, affected the degree of atomization; nozzle size played only a secondary role. Besides producing a wider range of atomization than did hollow cone nozzles, flat spray nozzles could also be used in more directions without an undesirable "drooling" of spray.

Spray pressure had no important influence on atomization at the airspeeds used in this study, but it becomes more significant at speeds below 80 m.p.h.☆

*Crop researchers locate*
*Algerian alfalfa that will serve as breeding stock for . . .*

# Weevil Resistant Alfalfa

*Stem from a susceptible alfalfa plant (center) has wounds where adult weevil punctured holes to lay eggs. Stems of the resistant Algerian strain are nearly free of the punctures.*

■ A strain of Algerian alfalfa that is resistant to egg laying by the adult alfalfa weevil could provide the breeding stock needed to develop desirable weevil-resistant alfalfas.

The importance of this finding is magnified by the fact that this destructive pest is developing resistance to insecticides. Weevils cause millions of dollars of damage to alfalfa crops each year, and all commercial varieties that have been tested are susceptible to the weevil.

North Carolina Agricultural Experiment Station and ARS scientists found that adult alfalfa weevils lay very few eggs in the stems of the Algerian alfalfa (*Medicago sativa* var. *gaetula* Urb.).

Larvae of the alfalfa weevil do more damage to alfalfa crops than adults do. An alfalfa plant that does not provide adults with suitable egg-laying sites, however, would have a form of resistance because it would interfere with the normal life cycle of the weevil.

### Adult weevils ignore Algerian strain

W. V. Campbell. State entomologist, and J. W. Dudley. ARS plant geneticist, found in laboratory and greenhouse tests that adult weevils tend to ignore *gaetula*. This alfalfa is not commercially acceptable, but Dudley believes that the characters that make it weevil resistant can be transferred to commercial varieties. Considerable breeding effort will be required to develop a desirable alfalfa that will retain a high degree of weevil resistance.

By following laboratory and greenhouse testing, the scientists could manipulate the insect population and evaluate adult weevil preference for feeding and egg laying in the absence of larval damage. Plants were exposed to an adult weevil population far greater than is normally found in the field.

### Only 0.03 eggs per inch of stem

In the laboratory experiment, the resistance of *gaetula* to the alfalfa weevil approached immunity when compared with the other *Medicago* species tested. *Gaetula* averaged 0.03 egg per inch of stem, while the most susceptible species in the test, *M. intertexta* (L.) Mill., averaged 33.8 eggs per inch of stem. The resistance of *gaetula* to egg laying was repeatedly confirmed in greenhouse experiments.

The scientists do not yet know why the alfalfa weevil *Hypera postica* (Gyll.), largely avoids *gaetula*, but they believe that stem type may have something to do with egg laying. *M. intertexta* has nearly hollow square-shaped stems that provide a large cavity for the weevil's eggs. *Gaetula* has round, nearly solid stems. Thus, it is more difficult for the female weevil to excavate a cavity in the stem of *gaetula* before she can deposit eggs.

Some eggs deposited in *gaetula* stems were not viable. Eggs that were placed near the surface of the stem were often forced to the outside of the stem by the formation of callus tissue at the stem wound. The callus tissue, formed as a protective covering, became enlarged to encompass an abnormally wide area, and the pressure exerted to close the wound forced the eggs to the outside.

Breeding work is underway to transfer the weevil resistance characteristic of *gaetula* to commercially acceptable alfalfa.☆


# Does It Pay To Fertilize Native Grasslands?

*Agronomists more than doubles beef yields on prairie grasses*

■ Increased beef gains in ARS research indicate that fertilizing native pastures with nitrogen has high potential in the eastern third of the northern Great Plains.

A mixture of prairie grasses makes up this semiarid region's native vegetation; cool-season grasses, primarily western wheatgrass, produce most of the forage, then give way to blue grama during the warm season.

Fertilization of these grasses has generally been considered uneconomical, even though limited experimental data has shown that fertilizer does increase forage production. Current investigations indicate that increased per acre returns could justify the added cost of fertilizer, but further research is needed before clear-cut recommendations can be made.

In a 6-year study at Mandan, N. Dak., ARS agronomists G. A. Rogler and R. J. Lorenz found that average beef gains increased 88 percent per acre on pastures fertilized with 40 pounds of nitrogen, and 146 percent on pastures fertilized with 80 pounds of nitrogen. Converting these percentages to pounds of beef produced, average beef gains were 48 pounds per acre on nonfertilized pastures, 90 pounds per acre with 40 pounds of nitrogen, and 118 pounds per acre with 80 pounds of nitrogen.

These results should be of special interest to cattlemen in the northern Great Plains, where forage ultimately goes into livestock production.

In this study, Rogler and Lorenz evaluated the effects of nitrogen fertilization of beef gains, carrying capacity, forage production, and vegetation. Ammonium nitrate was applied as a top dressing to two pastures each fall at rates of 40 pounds and 80 pounds per year. A third pasture was left unfertilized. Hereford steers, averaging 530 pounds at the start of the season, were rotated during the 140-day grazing seasons to keep the pastures in good condition.

Increases in carrying capacity and forage production on the fertilized pastures closely paralleled increases in beef gains per acre. The average number of acres required per head for the three treatments were: no nitrogen, 5.35 acres; 40 pounds of nitrogen, 2.80 acres; and 80 pounds of nitrogen, 2.17 acres.

Rogler and Lorenz point out that increased forage production on the fertilized pastures permitted the grazing of more animals per unit area. Gains per head were similar for all treatments, but total gain per acre was higher on the fertilized pastures.

Some management problems were created by fertilization. Wheatgrass showed marked early spring response to applications of nitrogen. In pastures receiving high rates of nitrogen, for example, the increased production of wheatgrass tended to crowd out blue grama. This adverse effect on blue grama decreased the amount of palatable grass available for summer grazing—and opened the land to erosion.

The scientists are now attempting to develop management systems for fertilized pastures that will reduce the loss of blue grama but still maintain increased wheatgrass yields.

Before making general fertilizer recommendations, the scientists want to study two other problems: (1) Reluctance of animals to graze cool season grasses as they mature and become less palatable, and (2) the response of undesirable annual and perennial grasses and weeds to nitrogen.☆

*Rabbits help detect...*

# Bacterial Spot In Peppers

■ Bacterial spot in pepper plants can be quickly and reliably detected by three techniques perfected by ARS scientists.

All three techniques involve the use of antiserum that develops in the blood of rabbits that have been injected with the bacterium. The antiserum causes a reaction when it is mixed with leaf sap extracted from diseased plants.

These serological techniques were adapted to detect bacterial spot of peppers at the Georgia Coastal Plain Experiment Station, Tifton, by ARS plant pathologist D. J. Morton.

Quick, reliable detection of bacterial spot is especially important to growers in the Tifton area because they grow most of the transplants that are shipped to areas east of the Mississippi River. These growers want to make sure that disease organisms are not introduced into pepper-producing areas by the transplants.

Bacterial spot is a most troublesome disease in this respect. Under conditions of severe rain and wind, the bacterium of this disease can spread rapidly—from just one infected plant—to infect large areas of fields.

Pepper plants infected by bacterial spot develop dark spots on leaves and fruit. But when transplants are inspected for the disease, it is not always possible to tell if the plants are infected. Diseased plants may show only very mild symptoms, and non-infected plants may have suspicious lesions.

Conventional methods used to identify the disease take several days—too long a time to be of value when prompt decisions must be made about shipping. So a program was started at Tifton to try to develop faster disease detection methods.

Morton prepares antiserum for bacterial spot tests by injecting rabbits several times during a period of one month with a suspension of the bacterium. He then obtains some of the animals' blood and separates the antiserum from the blood.

In one technique, Morton combines the antiserum with a fluorescent dye and places the mixture on top of some dried leaf sap smeared on a glass slide. If the disease-producing bacteria are present in the sap, the anti-serum-dye mixture sticks to the bacteria and appears as bright rods in an ultraviolet light microscope.

Another technique consists of simply adding one drop of the antiserum to one drop of purified leaf sap. If disease-producing bacteria are present, white clumping occurs.

In the third technique, tiny particles of bentonite clay, dyed blue, are used to adsorb the antiserum. This material is then added to a drop of purified sap. If the bacterial spot organisms are present, the clay particles quickly clump together.☆

## Plastic mulch provides head start

Raising the soil temperature in corn fields by covering the area with plastic mulch may help a warm-climate hybrid feel at home in a cool climate. But New York tests indicate that the same treatment helps an adapted hybrid even more.

Plastic mulching increased the yield of a warm-climate hybrid more than 15 percent in the cool climate near Marcellus. An adapted hybrid got an even bigger boost—plastic mulching increased its yield more than 25 percent.

These tests, covering 3 years (1961–63) were conducted by ARS soil scientists G. R. Free and C. E. Bay in cooperation with Cornell University's Agricultural Experiment Station.

The two grain hybrids—Cornell M–10 and Robson 350—were grown on 20- by 25-foot experimental plots of Honeoye silt loam. The M–10 hybrid is adapted to the Marcellus area; the R–350 hybrid is recommended for Long Island, where the growing season is longer and warmer.

Some of the plots were mulched with translucent plastic immediately after seeding; the mulch stayed on the plots until harvest. After the seedlings had emerged, the plastic was slashed between the corn rows to allow rain to penetrate the soil. Unmulched plots of each hybrid served as checks.

*Corn grown under plastic (right) gets a head start on corn grown without the mulching material.*

Both hybrids had about the same early growth rate under the plastic mulch.

Average yield for the M–10 hybrid was 128 bushels per acre on plastic-mulched plots; yield for the R–350 hybrid was 119 bushels. On unmulched plots, both hybrids averaged about 100 bushels per acre.

While in neither case was yield increase sufficient to make plastic mulching economical for corn production, the scientists feel the technique may become a useful research tool for evaluating hybrid-corn varieties.

## Cool area corn has more amylose

Geographical areas of the United States that have the coolest temperatures during the growing season produce corn with a higher amylose content than do areas where warmer temperatures prevail. ARS and Missouri Agricultural Experiment Station scientists reached this conclusion after analyzing data from a 2-year study in which high-amylose hybrid corn was grown in 12 States.

High-amylose starch is used industrially to produce durable fibers, plastics, and transparent films.

Of the hybrid-corn samples studied, amylose content ranged from an average high of 69.2 percent in Michigan to an average low of 61.5 percent in Mississippi. Percentage differences were greater between regions covered in the study than from year to year within each region.

Environmental conditions other than temperature also affected the amylose level but to a much lesser degree.

In the current tests with hybrid corn the scientists obtained location and temperature results that are comparable to earlier tests with high amylose inbred corn. The tests ran for 3 years at eight locations.

## Increasing cottonseed germination

ARS scientists have shown that germination of impermeable cottonseed can be increased substantially by electrical methods.

In seed having a germination of 5 to 7 percent, germination was increased to 81 percent with a glow-discharge treatment and to 28 percent with radio frequency. The research was conducted by agricultural engineers R. B. Stone and S. O. Nelson, plant physiologist M. N. Christiansen, and agronomist N. E. Justus.

Cottonseed used for the tests was from 16–B–7, a selection that normally produces seed with an impermeable external seed coat. Although the hard seed covering causes low germination, it protects the seed from possible field and storage deterioration.

The need now, the scientists say, is for a practical method of dry-treating seed in large-scale lots. Hot water treatments or mechanical abrasion are commonly used by researchers to break impermeability of small quantities of cottonseed.

For the glow-discharge treatment, the scientists place the seed in a single layer in a horizontal glass tube. The ends of the tube are sealed with rubber stoppers through which tubular electrodes are inserted. The electrodes, spaced 18 inches apart, are connected electrically to a high-voltage source.

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Treatments of 60 cycles per second and 15 kilocycles per second were about equally effective.

For the radio-frequency treatment, seed is placed in polystyrene boxes between parallel-plate electrodes of a radio-frequency oscillator. This treatment increased germination but was less effective than the glow-discharge treatment.

## Ronnel controls horn, heel flies

Horn and heel flies can be controlled effectively by feeding ronnel, a systemic insecticide, in a mineral salt mixture free choice to cattle on pasture.

Scientists of ARS and the Georgia Agricultural Experiment Station obtained 89- and 97-percent control of horn flies in tests with ronnel at Experiment and Eatonton. In earlier tests to control heel flies (*Hypoderma lineatum*), this insecticide, used in the same manner, resulted in 95-percent control.

Although several methods are commonly used to control these pests, the researchers say that ronnel, fed in either block or granular salt mixtures. proved the simplest yet tested. The studies are designed to find the most economical and easiest methods of control.

The blood-sucking horn fly (*Haematobia irritans*), which ranks as one of the worst pests of U.S. cattle, spends its entire life on a cow, concentrating on the back, neck, and base of the horns.

Heel flies and their larvae (cattle grubs) cause losses to the cattle industry estimated at $150 million annually through reduced milk production and weight gains, damaged hides and carcasses, and injury to cattle attempting to escape the fly. Most of these losses were prevented by feeding ronnel.

## Control is found for water belly

Ammonium chloride will protect sheep and cattle from urinary calculi ("water belly"), a disorder common to farm and laboratory animals, ARS-Texas research has shown.

In animals with this disease, caused by various nutritional imbalances, stones form in the kidney and urinary tract, similar to kidney stones in humans. It affects sheep, cattle, mink, horses, cats, dogs, and laboratory rats.

By using ammonium chloride ($NH_4CL$), available from any mineral supplement supplier, ARS and Texas A. & M. University scientists protected lambs and steers from illness and death in 3-year tests conducted at College Station and Big Springs.

When test animals were fed a basic diet of sorghum grain, cottonseed meal and hulls, and molasses—without ammonium chloride—38 percent of the lambs and 83 percent of the steers developed urinary calculi.

When ammonium chloride was added to the basic diet, the incidence of stones was entirely eliminated among the steers and reduced to 10 percent among the lambs. The ammonium chloride was fed daily at a rate of 1½ ounces to steers and ¼ ounce to lambs.

Stones among those lambs still affected after treatment were very small and passed easily in the urine. None of the test lambs fed $NH_4CL$ became ill or had stones in the urinary tract when they were slaughtered.

Sodium chloride (table salt) is added to the diets of farm animals in certain areas of the Southwest as a control measure against urinary calculi. In the Texas tests, however. sodium chloride reduced the incidence of the disease by only 7 percent, and some of the lambs still became ill.

In the 3-year test, 83 percent of steers on the basic diet had stones in their bladders. None of the steers supplemented with $NH_4CL$ had stones.

Ammonium chloride is the best supplement found. to date, for lambs and cattle. Research on other susceptible animals will have to be conducted before it will be known if this supplement will universally reduce incidence of calculi.



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